A "Greener" Fertilizer for Growing Horticultural Crops

Plants require certain elements for normal growth, including small amounts of micronutrients like iron, manganese, copper, and zinc. Fertilizers that provide these micronutrients often include certain synthetically produced organic compounds known as "chelating agents," raising concerns about whether their runoff into waterways increases levels of heavy metals.

An Agricultural Research Service scientist with the U.S. Horticultural Research Laboratory (USHRL), in Fort Pierce, Florida, is testing a relatively new, natural, and "greener" chelating agent as an alternative to the synthetic ones.

To make sure plants take up sufficient quantities of the micronutrients they need, growers use fertilizers formulated with chelating agents. These compounds bind with the micronutrients so they are available in the root zone. "Chelating agents also allow growers to maintain concentrated fertilizer stock solutions that contain soluble micronutrients. Growers can dilute these solutions and inject nutrients into their irrigation water," says horticulturalist Joseph Albano.

The effectiveness of a chelating agent to supply micronutrients to the plant is a balancing act that depends on soil or potting mix pH level. If the pH is too high, the metals become insoluble and are unavailable to the plant, even with the use of chelating agents, and this leads to nutrient-deficiency disorders. If pH is too low, metals become soluble, and in combination with chelating agents, they may become toxic. Marigolds, vinca, impatiens, and geraniums are particularly susceptible to nutrient disorders caused by iron and manganese toxicity, referred to as "bronze speckle" or "micronutrient toxicity syndrome." Symptoms of the syndrome can vary, but leaves of affected plants often develop chlorotic (yellowing) and necrotic (dead tissue) speckling that can progress to total leaf necrosis. The development of this disorder greatly decreases the value of ornamental plants.

EDTA and DTPA are the most common chelating agents used in formulating soluble fertilizers for floral and nursery crop production because they can "deliver" micronutrients within the recommended pH range for growing most of these crops. But they pose problems. When complexed with iron and exposed to sunlight, they degrade quickly, so growers need to store chelate-containing fertilizers in opaque containers. A more pressing concern, though, is that they are not readily biodegradable and persist in the environment for some time. They can also extract metals from sediments, and their use is believed to add to the amounts of iron and other heavy metals in waterways. EDTA is a particularly popular chelating agent and is used in many industrial processes and municipal products in addition to horticultural fertilizers. But concerns about its use in Europe have prompted calls there for the use of alternatives whenever possible.

Albano thinks he has found a "green" alternative for U.S. growers. Known as "EDDS," the chelating agent is just as effective as EDTA and DTPA at delivering micronutrients to plant roots. But EDDS is biodegradable, meaning that it will not persist in the environment and thus is less likely to take up and transport heavy metals in soils and waterways. EDDS is "gaining favor in Europe because it degrades in weeks as opposed to months," Albano says.

In a series of greenhouse studies, Albano grew marigolds for 47 days in containers filled with standard soil-less potting media. He used fertilizers formulated with EDDS, EDTA, or DTPA. Each of the three treatments was chelated with iron so that Albano could assess how much iron the marigolds were taking up, their overall health and growth patterns, and how quickly the iron-chelates degraded when exposed to light.

The results showed that iron-EDDS degraded more quickly when exposed to light, but that there were no significant differences in plant health, growth patterns, or in the micronutrient levels found in plant tissue. The report, published in *HortScience,* was the first peer-reviewed study to evaluate EDDS as a chelating agent in fertilizers used on a horticultural crop, Albano says. He has also coauthored a chapter on chelating agents in a book on best management practices for container-grown horticultural crops. The work is expected to encourage use of EDDS as an environmentally friendly chelating agent in formulating fertilizers used in the production of floral and nursery crops.—By **Dennis O'Brien,** ARS.

The research is part of Crop Production (#305) and Water Availability and Watershed Management (#211), two ARS national programs described at www.nps.ars.usda.gov.

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Horticulturist Joseph Albano (right) measures chlorophyll levels in leaves of marigolds treated with the chelating agent EDDS, and technician Chris Lasser measures iron levels in iron chelate samples.